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# Platform Competition in Pay-TV Market

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## 【 Summary 】

In this paper, we undertake an empirical analysis of the current Japanese pay-TV market, where cable TV carriers and CS digital satellite carriers are the main players. After examining the factors for subscribing to pay-TV and the competitive situation in the market, we have the following findings;

- (1) Cable TV carriers promote high value-added service provision, such as bundling internet access, and these activities result in competitive superiority over CS carriers.
- (2) Cable TV carriers receiving bigger investment from local governments tend to gain higher rates of subscription, although they provide smaller numbers of channels with a low charge.
- (3) The number of terrestrial broadcasting channels which are transmitted via pay-TV carriers can have a large impact on competitive advantage when getting subscribers in the pay-TV market.

Keywords: Platform Competition, Cable Television, Communication Satellite,  
Pay-TV, subscriber penetration, high-value added service

## 1. Introduction

Cable TV service was introduced as a means of retransmitting terrestrial broadcasting services to households in remote and mountainous areas where people cannot obtain those services directly. In addition, cable TV businesses need huge initial investments in order to start providing services. These business features make it difficult to enter the market voluntarily and it is understood that this was a good reason for supporting business entry by issuing a terrestrial monopoly cable TV license in each area.

The cable TV business environment has changed, however, and competition with other media industries has intensified. We can categorize the changes into two different types. One is internal changes of the cable TV industry and the other is external changes of the industry. As for the internal changes, we can point out several facts such as the digitalization of broadcasts, the enhancement of receiving terminals, and the increase in multi-channel services. As for the external influences on the industry, the most important impacts are the dissemination of the Internet and broadband services which stimulate the provision of various means for delivering video content.

On the other hand, there is different regulatory framework for broadcast business and telecommunication business. Cable TV operators are under related laws and regulations along with other terrestrial broadcasting operators and satellite TV operators.<sup>1</sup> Therefore, the market environment that each media industry faces are thought to be different as they are influenced by specific regulations and related policies.

The consumers, however, do not necessarily recognize the exact scheme of regulations and laws. Those programs that they enjoy are essentially similar and do not depend on the media through which they transmitted. This kind of gap in terms of perception between the supply side and the demand side may become bigger as the convergence of broadcasting and telecommunications occurs.

Based on these circumstances, this study tries to analyze the competitive situation in the Pay-TV market in terms of “platform competition”<sup>2</sup> among cable TV operators and satellite TV which are the main players in this market. In other

words, we conduct a quantitative analysis taking related policies and technological features into consideration.

This paper has the following structure. In section 2, we overview the business environment of the broadcasting market. Section 2.1 covers the situation in the United States and section 2.2 covers Japanese market in which terrestrial broadcasting has a major presence. Then, related previous studies are reviewed in section 3. We explain the method we adopted for this study in section 4. Section 5 shows the results of our analysis. Section 6 gives the conclusion and describes some of the implications of our study.

## **2. Overview of Pay-TV market**

### **2.1. Unites States market**

As it is well known, cable TV service has been penetrated in the United States<sup>3</sup> and the high costs and low level of services which may be caused by monopolies in designated areas have been policy issues. The policy authority dealt with this matter by regulating directly in terms of the controlling charges that operators can set.<sup>4</sup> At the same time, promoting other service operators in the multi-channel market has also been a policy issue and the Direct Broadcast Satellite (DBS) service has developed as a potential competitor for cable TV operators. DBS started its business as a supplemental service for cable TV where there is no cable TV infrastructure.<sup>5</sup> But the number of subscribers has increased as it differentiates its service from cable TV by providing specific program formation and service packages. This success makes DBS a competitor of cable TV.

As the market situation changed, the propensity of regulation policy moved from “ensuring diversity of services” to “improving economic welfare through competition”. A major policy change was the implementation of the Telecommunication Act 1996 which allowed telephone companies and cable TV operators to enter other’s markets. As far as cable TV operators are concerned, they have invested a lot in digital network infrastructure since then in order to compete with other services. At the same time, business integration has been stimulated in order to achieve effective management and strengthen market share. Cable TV operators started to sell franchise companies that are located in scattered areas and

to merge with or acquire those which are geographically located in a neighboring area.

Since Multi System Operator (MSO) can control the access level to its own network, MSO's integration with cable TV operators could provide advantages in competition. On the other hand, this kind of integration may hinder competition between service operators, and result in a decrease in economic welfare and consumer benefit. Therefore, the policy trend has moved towards the issue of ownership.<sup>6</sup>

In case of DBS, business integration among companies in the same trade has progressed along with digitalization, and there is oligopoly.<sup>7</sup> The operators enjoy oligopoly status and are actively trying to get monopoly broadcasting rights. Unlike cable TV which integrated with MSO to which program access rule is applied, DBS enjoys a relatively deregulated policy framework.

Under this rapid changing environment of Pay-TV market in the U.S., the policy trend moves toward ownership regulation, especially content ownership which is one of the key elements for service differentiation. This is because there will be less and less difference between platform infrastructures as the technology develops and improve rapidly in this ICT related business. But it is necessary to remember that there is a history of pro-competitive regulation policies in the last decade<sup>8</sup>, and the policy experience of U.S. may give useful implications for the Japanese policy framework.

## **2.2 Japanese market**

In the Japanese Pay-TV market, cable TV and Satellite Broadcast are the key platform operators.

In Japan, cable TV business started by re-transmitting terrestrial broadcasting for areas where it is difficult to capture terrestrial TV because of mountains or high buildings. Therefore, local government provided some financial incentives to the cable TV operators.

In 1985, there was “a big bang” deregulation of telecommunication business and this has influenced the cable TV business environment which has changed drastically as the convergence of telecommunication and broadcast systems have

become technically feasible. In response to these changes, the Ministry of Posts and Telecommunications had implemented several deregulations.

Soon after the initial stage, some cable TV companies started to add their own TV programs in their services and later new types of companies called urban type cable TV entered the cable TV market. This urban type usually has more than 5 self-produced channels and re-transmits satellite TV programs. As such, multi-channel business has developed and the new entry of MSO played a role in improving cable TV business efficiency.<sup>9</sup>

In response to these changes, the Ministry of Posts and Telecommunications had implemented several deregulations.<sup>10</sup>

Cable TV business tends to be monopoly in designated areas because of its history and there is always the possibility that the price cable TV operators set for their services may distort the efficient price level. In Japan, cable TV service started as a supplement function for terrestrial TV and governments supported cable TV operators with financial incentives in order to set prices at relatively low levels. At the same time, the size of cable TV was regulated which may cause some discrepancies with respect to the optimum operation size.<sup>11</sup> Because of deregulation, cable TV operators are facing a competitive market environment and it is expected that the size of coverage for a cable TV will widen and this problem of optimum operation size will be solved.

On the other hand, when the Communication Satellite Broadcast business was introduced, the policy framework of this business categorized market players into two groups, one is distributors of TV programs and the other is suppliers of TV programs. Distributors of TV programs operate and maintain satellite facilities as infrastructure. Suppliers of TV programs make TV programs. In addition, there is a platform business between them which manages customer (subscriber) relations.

When this new service was started, several advantages of CS were mentioned such as 1) broad area coverage, 2) multi-channel, and 3) new and high quality data service. However, there were several accidents such as satellite launch failures and satellite malfunctions and the service was used for niche needs such as news video transmissions and TV conferences at the initial stage. The size of the Pay-TV

market has grown every year. The sales of CS broadcasting (both analog and digital) reached 234 billion yen (about \$ 2 billion U.S.D.) in 2004, which is more than 20% bigger than that of in 2002. The balance sheet of the CS broadcast industry as a whole has also improved during this period and the profit margin on sales is -0.7% in this industry.<sup>1 2</sup>

In terms of the competitive market environment of Pay-TV, CS broadcast is one of the most competitive businesses for cable TV. In the United States, it is becoming a policy issue of platform competition as the service competition between DBS and cable TV gets fierce.

### **3. Previous survey**

There are many studies in the field of Pay-TV in the United States as the multi-channels market in the U.S. is the most developed. As we have seen in previous sections, cable TV is characterized by a network infrastructure and its services tend to be a natural monopoly in a region. Therefore, academic surveys in this field have focused on the matter of regulation and/or deregulation of natural monopoly prices.<sup>1 3</sup>

However, Pay-TV market competition in the U.S. has become severe as DBS service has spread nation wide and of telephone companies have entered the market. Academic interests moved towards the study of effective competition among different platforms.

Karikari et al. (2003) analyzed the factors that affect the service penetration rate taking the level of pay TV market competition and dissemination of satellite TV into consideration. The results show that a region with a high cable TV fee based on regulation has higher penetration of satellite TV while a region where there are multiple companies such as CS, cable TV and telephone companies faced low satellite penetration. In other words, the level of competition among incumbent cable TV and new entries influences the level of penetration of satellite TV. In addition, value added services such as data transmission and digital broadcasting have a negative impact on satellite penetration.

Goolsebee and Petrin (2004) analyzed the impact of satellite TV on the cable TV market using subscribers data. They estimated the self elasticity of price and cross elasticity of prices for cable TV (both basic service and premium service), satellite TV and terrestrial broadcast with a discrete choice model. Based on the results of the analysis, they concluded that consumers regard satellite TV and cable TV premium as alternative services as the demand for cable TV premium service and satellite service are elastic compare with that of cable TV basic service. In addition, they estimated the degree of changes in price levels and consumer surpluses resulting from the entry of satellite TV companies into the market. According to the estimation, the subscription price decreased by 15% and the quality of service would have been worse if there were no entry.<sup>1 4</sup>

On the other hand, there are no previous studies that focus on platform competition in the Pay-TV market of Japan.

In the next section, we will explain the analytical framework that illustrates Pay-TV market competition.

#### **4. Estimation method and data**

In the U.S. the market for household subscriptions to Pay-TV services has been saturated and cable TV and DBS service providers are competing with each other in differentiating their services from others by providing value added services such as internet access, IP telephone. On the other hand, the number of subscribers is still growing because the market size of terrestrial broadcast is relatively big historically and the Pay-TV market is still an emerging service.<sup>1 5</sup> Therefore, we introduce several variables as proxies which represent the factors for subscriptions and the level of market competitiveness. Then we can analyze the influence of each factor for the market competition.

We have estimated four equations and each of them is described by equation (5) where the explained variables are the rate of cable TV subscription, the rate of CS subscription, the monthly charge for cable TV and the number of channels via cable TV.<sup>1 6</sup> As explaining variables, we adopt four categories, namely demographic factors specific to an area, policy and other institutional factors, and strategic



factors such the provision of value added services. Here is the equation we estimate.<sup>1 7</sup>

(dependent variables)=

$$\begin{aligned} & \beta_0 + \beta_1 (\text{income per capita}) + \beta_2 (\text{urban dummy}) + \beta_3 (\text{ratio of elder population}) \\ & + \beta_4 (\text{duration of cable TV business}) + \beta_5 (\text{ratio of government investment}) \\ & + \beta_6 (\text{number of terrestrial TV channels}) + \beta_7 (\text{capacity of channels}) \\ & + \beta_8 (\text{duration of internet business}) + \beta_9 (\text{ratio of fiber network in transmission}) \end{aligned} \quad (5)$$

There is a possibility that these four equations are correlated each other.<sup>1 8</sup> And we need to exclude the possibility of heterogeneous distribution. Therefore, we use SURE (Seemingly Unrelated Regression Estimation)<sup>1 9</sup> for our estimation.

In this study, we used the cable TV almanac (2004-2006) which providers related data for the years 2002 to 2004.<sup>2 0</sup> We re-calculate the number of CS subscribers according to the area where the designated cable TV operates. This means that we assume that there is a competition between CS and cable TV in that area.<sup>2 1</sup> If there is a blank in the data set of operators, we omitted it from the data set. We also conducted appropriate measures to deal with changes in the operation area, M&A, etc. As a result,<sup>2 2</sup> the size of the sample data becomes 401. We used logarithm values, except for dummy variables, in estimation.

-----Insert Table 1 & 2 about here -----

## 5. Estimation results

Estimation results are shown in table 3. Generally speaking, the number of significant explanatory variables is greater in the estimation for the cable TV subscription rate, (1), than in the estimation for the CS digital subscription rate, (2). This is reasonable because most of the variables used are direct information on the cable TV carrier, except for demographic variables. Considering that our sample is pooled data including the carrier's heterogeneity, it is possible to say that both  $\chi^2$  and  $R^2$  show acceptable values.

We divide the nine explanatory variables into three categories (each category includes three variables). The first category is demographic variables and includes “Income per capita,” “Urban dummy” and “Ratio of elder population.” The second category is variables that are restricted by institutional or political factors and includes “Duration of cable TV business,” “Ratio of government investment,” and “Number of terrestrial TV channels.” The third category is strategic variables which are determined by cable TV carrier and includes “Capacity of channels,” “Duration of internet business”, and “Ratio of fiber network in transmission.” We will discuss the estimation results in order, focusing especially on the rate of cable TV subscription and the rate of CS subscription (equations (a) and (b) in table 3).

When we consider the competitive relationship between a cable TV carrier and CS digital carrier, we should focus on significant coefficients that have opposite signs for the subscription rate equations, (a) and (b). These variables are “Ratio of elder population,” “Duration of cable TV business,” “Ratio of government investment,” “Capacity of channels”, “Duration of internet business”, and “Ratio of fiber network in transmission.” These variables show a positive sign in the equation for the rate of cable TV subscription and show a negative sign in the equation for the rate of CS subscription. Note that factors in the second and third categories show larger numbers than the demographic variables, which cannot be changed by the carrier. Especially, “Ratio of government investment”, “Capacity of channels” are significant signs in both equations. In other words, these factors work to increase the rate of cable TV subscription while they work to decrease the rate of CS subscription.<sup>2 3</sup>

As proxy variables for urban and depopulated regions, “Urban dummy” and “Ratio of elder population,” show significant positive signs only in the equation for the rate of cable TV subscription. This may reflect the fact that the rate of cable TV subscription is higher in urban regions because there is “economies of density” and is higher in depopulated regions because cable TV started as a complimentary media with terrestrial broadcast. The coefficient of “Number of terrestrial TV channels” in equation (a) is negative, and shows that the higher the number of TV programs for the terrestrial broadcast is, the higher the rate of cable TV subscription will be. In short, the number of terrestrial channels can affect the current and future competitive situation in the pay-TV market.<sup>2 4</sup>

Speaking of high-value added services, the coefficient of "Duration of internet business" shows a significant negative correlation with the rate of CS subscription<sup>2 5</sup> while the coefficient of the "Ratio of optic fiber network in transmission" shows significant positive correlation with the rate of cable TV subscription. Because these two variables have signs that are opposite to the sign for the rates of cable TV subscription and CS subscription, high-value added service is effective for "customer retention" by cable TV carriers to some extent. A cable TV carrier is said to have an advantage in both services because at the present moment these are primarily offered by wired transmission, so they are quite effective for cable TV carrier's strategy.

On the other hand, looking at the estimation results for the monthly charge of cable TV and the number of channels via cable TV, equations (c) and (d), households in urban districts seem to enjoy multi-channel services with a high monthly fee while households in rural districts seem to consume only basic services with a low fee that are provided by government invested cable TV carrier in general. Further, because "Capacity of channels" and "Duration of internet business" show significant positive signs for both the monthly charge of cable TV and the number of channels via cable TV, we guess cable TV carriers promote high-value added services and intend to increase average revenue per user (ARPU).

Karikari et al. (2003), which investigates pay-TV market in the U.S.A., obtained the same results for "Capacity of channels." They also showed that the "number of terrestrial local channels via cable TV" has a significantly positive effect on the rate of cable TV subscription and a negative effect on the rate of CS subscription. This is also consistent with our results. On the other hand, speaking of the original variables they adopted, a "Dummy variable which shows head-to-head competition with other cable TV carrier or telecommunications carrier" and a "Dummy variable for cable franchise affiliated with a top 10 MSO" also shows a significantly positive effect for the rate of cable TV subscription and a negative effect for the rate of CS subscription. (In this paper, we did not adopt them because they are not appropriate considering the Japanese pay-TV market.) These variables must be important factors when considering competition in the future Japanese pay-TV market. Especially, MSO will be important factor when consider future regulation because current regulation is assumes a "fragmented market" and MSO is a new form of

competition.

-----Insert Table 3 about here -----

## **6. Conclusion**

The results we get from our analysis can be summarized as follows.

- 1) Cable TV operators can get an advantage in competition against CS by providing high value added services such as internet access or optic fiber networks.
- 2) In service areas where cable TV operators get a high percentage of government investment, the penetration rate of cable TV subscribers is rather high while monthly fees are kept at a low level with a relatively small number of channels available.
- 3) In the business field of multi-channel service, cable TV and CS are competing with each other for subscribers to their services.
- 4) The number of channels of terrestrial broadcast may have a significant impact on the competition to bring new customers to the Pay-TV market.

As we have conducted in this study, it is necessary to recognize the factors that have an influence on subscriber penetration in order to accomplish effective competition between cable TV and CS as service platforms. In the era of convergence between telecommunication and broadcast, there are some other potential platform services for TV programs. In the future, these potential platforms should also be included as competitors in order to evaluate the market situation properly.

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## [Note]

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## [Footnotes]

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<sup>1</sup> In this paper, “subscription for satellite broadcasting carrier” formally means “subscription for satellite broadcasting carrier which uses communication satellite (CS) and provides platform service such as audience management.” In other words, it means “subscription for SKY Perfect Communications Inc.” Therefore, satellite broadcasting carriers which use broadcasting satellite (BS), such as NHK, WOWOW, are excluded.

<sup>2</sup> The word “platform” is sometimes used to mean that “the basic infrastructure which works on the physical network of ICT network and makes application software work (Hayashi (2003))”. However, in this paper, we use “platform” to mean “carriers which have different technologies and compete for providing telecommunication service to end users,” following the definition by Church and Gandal (2005).

<sup>3</sup> The subscription rate for all TV-owned households increased 13 % and reached 59% during 1985-90, then reached 69.2% in 2001. However, the number of subscribers tends to decrease after 2002.

<sup>4</sup> Rate regulation in the U.S.A. was once relaxed by “the cable communications policy act of 1984,” but was reinforced by the “cable television consumer protection and competition act of 1992” because subscription fee of cable television in '89, '90 and '91 increased faster than the inflation rate (according to a GAO report). Then, regulation was re-relaxed by the “Telecommunications act of 1996” because the purpose of this act was to introduce competition policy in telecommunications market. In addition to rate regulation, there are regulations for content and for merger/affiliation/acquisition.

<sup>5</sup> Primestar Inc., for which money was put up five major cable television companies, began to provide direct broadcasting service in July, 1990.

<sup>6</sup> Note that almost all the programs provided by cable network can be watched through DBS from a practical standpoint. This is because the Program Access Rule stipulated by the “Cable television consumer protection and competition act of 1992.” This act ensures that all multichannel video programming distributors (MVPD) can access cable networks that are distributed through communication satellites under equal conditions and prohibits vertically integrated cable network with MSO from making a deals with non business groups on unfair conditions and refusing access to its network.

<sup>7</sup> As of September 2005, the number of subscribed households for pay-TV was about 14.9 million for DirecTV Inc. and 11.7 million for EchoStar Inc.

<sup>8</sup> For example, issues on retransmission of local terrestrial broadcasting programs or on regulations for open network obligation when cable television carriers provide internet services.

<sup>9</sup> The financial condition of cable TV carriers, separated by years of operation, at the end of the fiscal year 2004 is as follows: 43% of carriers that had been operating for less than five years showed a loss on both a single-year basis and an accumulated basis; 82% of carriers that had been operating for

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between five and ten years showed a profit on a single-year basis; and 46% of carriers that had been operating for more than ten years showed a profit on both a single-year and an accumulated basis (Ministry of Internal Affairs and Communication (2006)).

<sup>10</sup> To give actual examples, (1) abolishment of local carrier requirement term for cable television business, (2) relaxation and abolishment of foreign investment regulation etc., (3) simplification of application form for construction permit of cable TV broadcasting facilities etc., (4) abolishment of adjustment for integration of multiple schemes between service providers, (5) realization of common use of head end, (6) practical application for radio transmission system which is compliment with cable television, (7) simplification of procedure for merger and disaggregation etc., (8) permission for cable TV carriers usage of telecommunication service, such as telecommunications facility which is provided by telecommunications carrier etc., (9) consolidation for regulation on cable television broadcasting facility using FTTH.

<sup>11</sup> Shiotani (2006) estimates the scale economy of cable TV carriers based on a production function and examines public support policy for widening of the operation area and scale expansion. Jitsuzumi and Nakamura (2002) analyzes the relationship between the scale and business efficiency of cable TV carriers based on a DEA (data envelopment analysis) method, and makes a suggestion of an alternative indicator if government offers financial support for cable TV carriers.

<sup>12</sup> The primary businesses of SKY Perfect Communications Inc. are CS digital broadcasting using CS at longitude 124/128 east and multichannel supply based on platform business using CS at longitude 110 east. At the current moment, the number of subscribers for CS at longitude 124/128 east is the largest because they were launched earlier. But SKY Perfect Communications Inc. has a medium- to long-term strategy to move their primary businesses areas to platform business using CS at longitude 110 east (e2 by SKY PerfectTV!). Further, they offer their service through wired line (optical fiber) if a household has difficulty watching SKY PerfectTV! because of the dwelling environment etc. ("Hikari PerfectTV!" offered by their subsidiary firm, Opticast Inc.)

<sup>13</sup> There are several previous articles which analyze rate regulation of cable industry such as Carroll and Lamdin (1993), Hazlett (1996) (1997), Hazlett and Spitzer (1997), Jaffe and Kanter (1990), Noam (1985), and Prager (1992). On the other hand, we can find some articles on market power increase (increase of usage fee or decrease of service quality) for cable TV carriers by deregulation such as Waterman and Weiss (1996), Hoekyun and Litman (1997) and Chipty (1995). Most of them have the consequence that rate regulation and ownership regulation for the market power of cable carriers are effective in order to preserve a competitive market condition.

<sup>14</sup> They also report that the increase of consumer surplus is estimated at \$127-190 per year for DBS subscribers and \$50-60 per year for cable subscribers with the new entrance of satellite broadcasting carriers.

<sup>15</sup> During 2002 to 2004, the number of cable TV (permitted institution for self-broadcasting) subscribers increased by 16.5%, 9.2% and 8.1% compared to the previous fiscal year while those of CS digital increased by 11.2%, 4.1% and 2.8%. In short, the number of subscribed households still increased while growth rate decreased.

<sup>16</sup> The variables subscription rate, subscription fee, and number of offered channels for cable TV and subscription rate for CS digital broadcast are endogenous (or simultaneously determined) variables of structural equations in the meaning that the decision of one variable is affected by the other three variables. In this paper, we show the result by reduced form equations for the following two reasons: (1) our purpose is to consider the impact of other factors (i.e demographic factors, institutional/policy factors, factors for carriers' strategy) on four endogenous variables, as we stated in the body of our paper. (2) reduced form results are easy to compare with Karikari et al.(2003).

<sup>17</sup> We decided not to treat one of the triple play services, "IP telephony," in this paper because there are few service providers at this moment.

<sup>18</sup> We estimate the correlation of residuals obtained from four equations. The correlation between the two equations on subscription fee and channels is 0.3249.



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<sup>1 9</sup> SURE (Seemingly Unrelated Regression Estimates) is one of the FGLS (Feasible Generalized Least Square) methods and has the following procedure with respect to the variance-covariance matrix for M equations.

$$Var(\varepsilon) = \Sigma = \begin{pmatrix} \sigma_{11}I & \dots & \sigma_{1M}I \\ \vdots & \ddots & \vdots \\ \sigma_{M1}I & \dots & \sigma_{MM}I \end{pmatrix}$$

Step 1: Estimate multiple equations (M units) by OLS and obtain residuals,  $\mathbf{e}_1, \mathbf{e}_2, \dots, \mathbf{e}_M$ .

Step 2: Estimate element  $\sigma_{ij}$  of  $Var(\varepsilon) = \Sigma$   $s_{ij} = \mathbf{e}_i' \mathbf{e}_j / n$ , and make  $\hat{\Sigma}$  based on  $\Sigma$ .

Step 3: Calculate estimated value of  $\beta$  based on  $(\mathbf{X}'\hat{\Sigma}^{-1}\mathbf{X})^{-1}\mathbf{X}'\hat{\Sigma}^{-1}\mathbf{Y}$ .

<sup>2 0</sup> Refer to figure 1 for constructing of variables and the data source, and to figure 2 for descriptive statistics of the data used in our analysis.

<sup>2 1</sup> We obtained data on the number of CS subscribers from SKY Perfect Communications Inc. and recount it by each fragmented market. We are very grateful for their cooperation.

<sup>2 2</sup> We use the following three methods of data processing. (1) If the name of a company was changed during the period of analysis but some other information including the number of households is the same as before, we treat it as one carrier. (2) If the name of the company was changed during the covered period and some other information including the covered number of households is also changed, we treat it as another carrier in order to avoid discontinuity of the subscription rate. (3) If the company was merged during the covered period, we treat it as another carrier.

<sup>2 3</sup> Speaking of “the number of maximum channels based on capacity of broadcasting facility,” it is considered as a strategic variable to some extent under a deregulated situation because a carrier can change it by himself by reinforcing his own facilities or merger etc. Taking a look at the correlation coefficient, the value with “the number of elapsed months from starting time of providing internet service” (0.3711) shows the highest number and exceeds those with “capital stock” (0.3065). This may show that the decision for whether a cable company should provide internet services or not seems to be determined independently from its scale.

<sup>2 4</sup> Shishikura, Kasuga and Torii (2006) analyse factors for subscribing to pay-TV services in Japan and show that basic channels have high elasticities while specialized channels have low elasticities. Clements and Brown (2006) analyze the competitive situation in the U.S. pay-TV market after SHVIA (Satellite Home Viewers Improvement Act) and find that the subscription fee of cable TV is significantly low in areas where a cable TV carrier and a DBS carrier, both of which provide local program re-transmission, compete.

<sup>2 5</sup> According to White Paper on Telecommunications (FY 18), the number of internet subscribers through cable TV is 3.31 million. This is smaller than those of DSL (14.52 million) and those of FTTH (5.46 million), and may affect our estimation results.

Table 1 Descriptive Statistics

	Definition of variables and data sources
<b>Dependent Variables</b>	
Rate of cable TV subscription	= number of subscribed household / total number of household in the area (delete if it shows over 1) <i>Cable TV Almanac</i>
Rate of CS subscription	= number of subscribed household / total number of household in the area (delete if it shows over 1) <i>Cable TV Almanac</i> and <i>CS digital carrier</i>
Monthly charge of cable TV	= monthly charge of basic cable TV channels (only for broadcasting service) <i>Cable TV Almanac</i>
Number of channels via cable TV	= total number of channels offered by cable carrier <i>Cable TV Almanac</i>
<b>Explanatory Variables</b>	
Income per capita (million yen)	= taxable income / total population in the operating area <i>Basic Resident Register</i>
Urban dummy	= 1 if the operating area is Tokyo or government-designated city (at the end of fiscal year 2004)
Ratio of elder population	= population over 65 years old / total population in the operating area, <i>Basic Resident Register</i>
Duration of cable TV business	= number of passed months since beginning of offering cable TV service until the end of fiscal year 2004 <i>Cable TV Almanac</i>
Ratio of government investment	= amount of government investment / capital fund (delete if it shows over 1) <i>Cable TV Almanac</i>
Number of terrestrial TV channels	= number of terrestrial broadcasting carrier in the operating area <i>Almanac on Japanese Private Broadcasting</i>
Capacity of channels	= number of channels for which cable carrier's facility can transmit <i>Cable TV Almanac</i>
Duration of internet business	= number of passed months since beginning of offering internet service until the end of fiscal year <i>Cable TV Almanac</i>
Ratio of fiber network in transmission	= length of optical fiber / total length of cable (delete if it shows over 1), <i>Cable TV Almanac</i>

Table 2 Descriptive Statistics

	Mean	S.D.	Minimum	Maximum
<b>Dependent Variables</b>				
Rate of cable TV subscription	0.4686	0.2033	0.0640	1.0000
Rate of CS subscription	0.1047	0.1282	0.0000	0.8653
Monthly charge of cable TV	2871	671	840	4463
Number of channels via cable TV	47.2444	16.5198	11	126
<b>Explanatory Variables</b>				
Income per capita (million yen)	1.3821	0.2827	0.8129	2.2433
Urban dummy (= 1 if it is urban district)	0.1122	0.3160	0	1
Ratio of elder population	0.1927	0.0382	0.0879	0.3405
Duration of cable TV business	165.8529	63.7666	48	486
Ratio of government investment	0.0868	0.1643	0.0000	0.9807
Number of terrestrial TV channels	4.4539	1.3815	1	6
Capacity of channels	65.7581	22.7122	21	137
Duration of internet business	57.7781	15.4654	0	108
Ratio of fiber network in transmission	0.1487	0.1075	0.0000	0.8421

Table 3 Estimation Result

Dependent Variables(Logarithm) Explanatory Variables(Logarithm)	Pay TV subscription rate		Business index of cable carrier	
	Cable TV (a)	Sattelite (b)	Rate (c)	# of offered channels (d)
Income per capita	0.142 *** 4.11	0.761 *** 15.09	-0.010 -0.55	-0.005 -0.24
Urban dummy (0 or 1)	0.153 ** 2.04	0.095 0.87	0.142 *** 3.52	0.104 ** 2.49
Ratio of elder population	0.226 * 1.75	-0.164 -0.87	-0.205 *** -2.94	-0.328 *** -4.55
Duration of cable TV business	0.288 *** 4.44	-0.123 -1.30	-0.023 -0.65	-0.082 ** -2.26
Ratio of government investment	0.042 *** 3.02	-0.041 ** -2.00	-0.026 *** -3.39	-0.029 *** -3.77
Number of terrestrial TV channels	-2.098 *** -3.47	-0.088 -1.00	0.096 *** 2.94	-0.004 -0.12
Capacity of channels	0.254 *** 3.33	-0.280 ** -2.52	0.097 ** 2.36	0.398 *** 9.40
Duration of internet business	0.019 0.27	-0.203 ** -1.97	0.108 *** 2.83	0.171 *** 4.34
Ratio of fiber network in transmission	0.059 * 1.92	-0.013 -0.29	0.006 0.33	-0.006 -0.33
Constant	-2.766 *** -4.98	-1.566 * -1.93	6.661 *** 22.18	1.229 *** 3.97
$\chi^2$	89.90	292.15	134.35	399.66
R-square	0.1831	0.4215	0.2510	0.4586
Number of samples	401	401	401	401

\*\*\* shows significant at 1% level

\*\* shows significant at 5% level

\* shows significant at 10% level